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THE WORK OF THE TRUCKEE-CARSON RECLAMATION PROJECT EXPERIMENT FARM IN 1913.

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INTRODUCTION.

This circular is issued for the purpose of reporting the progress made in the investigations being conducted at the Truckee-Carson Experiment Farm and is supplementary to reports previously published.[1]

The reclamation of lands containing alkali salts in excess of the amount tolerated by alfalfa and other cultivated crops is the problem to which the greatest amount of attention has been given since the establishment of the experiment farm in 1906. Experiments have also been made in testing varieties of general farm crops and horticultural crops. A report of the progress made in these experiments in 1913 is presented in this paper.

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[1] The publications in reference to the Truckee-Carson Reclamation Project issued by the Bureau of Plant Industry are as follows:

The Truckee-Carson Experiment Farm, by C. S. Scofield and S. J. Rogers, 1909. (Bulletin 157.)

Bacteriological studies of the soils of the Truckee-Carson Irrigation Project, by K. F. Kellerman and E. R. Allen, 1911. (Bulletin 211.)

Agricultural observations on the Truckee-Carson Irrigation Project, by F. B. Headley and Vincent Fulkerson, 1911. (Circular 78.)

The nematode gallworm on potatoes and other crop plants in Nevada, by C. S. Scofield, 1912. (Circular 91.)

Agriculture on the Truckee-Carson project: Vegetables for the home garden, by F. B. Headley and Vincent Fulkerson, 1913. (*In* Circular 110.)

Commercial truck crops on the Truckee-Carson project, by F. B. Headley and Vincent Fulkerson, 1913. (*In* Circular 113.)

Climatic conditions on the Truckee-Carson project, by F. B. Headley, 1913. (*In* Circular 114.)

Fruit growing on the Truckee-Carson project, by F. B. Headley and Vincent Fulkerson, 1913. (*In* Circular 118.)

The work of the Truckee-Carson Experiment Farm in 1912, by F. B. Headley, 1913. (*In* Circular 122.)

CONDITIONS ON THE PROJECT.

WEATHER CONDITIONS.

Records of temperature, wind velocity, evaporation, humidity, and precipitation are kept in cooperation with the United States Weather Bureau, the Biophysical Laboratory of the Bureau of Plant Industry, and the University of Nevada, all of which have supplied instruments suitable for the investigations in which they are interested. The results of these observations are summarized in Table I.

TABLE I.—*Summary of climatological observations at the Truckee-Carson Experiment Farm, 1906 to 1913, inclusive.*

PRECIPITATION (INCHES).

Year, etc.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average for 8 years, 1906 to 1913	0.69	0.29	0.49	0.49	0.58	0.43	0.24	0.20	0.27	0.36	0.32	0.55	4.91
For the year 1913	.25	.21	.26	.25	2.15	.99	1.53	.94	.03	.04	1.14	.30	8.09

EVAPORATION (INCHES).

Average for 6 years, 1908 to 1913	1.46	1.95	3.55	6.07	7.98	9.84	10.44	9.49	6.23	3.77	2.07	0.76	63.61
For the year 1913	2.57	1.88	3.71	6.79	8.03	7.86	9.45	7.77	7.10	4.06	1.66	0.54	61.42

DAILY WIND VELOCITY (MILES PER HOUR).

Average for 4 years, 1909 to 1913	3.55	3.68	4.95	5.88	4.66	4.30	3.38	2.73	3.11	3.05	3.16	2.81	3.77
For the year 1913	4.17	3.24	4.66	5.99	4.45	3.74	3.44	2.30	2.54	2.48	2.65	2.78	3.54

SKY.[1]

Prior to 1913 (days):													
Clear	13	15	16	19	18	22	21	24	21	22	18	14	223
Partly cloudy	7	7	9	7	10	5	5	4	5	4	5	5	73
Cloudy	11	6	6	4	3	3	5	3	4	5	7	12	69
For the year 1913 (days):													
Clear	16	17	15	16	12	15	14	15	23	21	10	12	186
Partly cloudy	7	7	10	5	16	7	7	11	6	4	6	5	91
Cloudy	8	4	6	9	3	8	10	5	1	6	14	14	88

TEMPERATURE (°F.).

Absolute maximum:													
8 years, 1906 to 1913	70	72	79	89	102	101	103	103	95	88	81	72	.....
For 1913	64	61	79	81	91	88	99	96	95	81	73	62	.....
Absolute minimum:													
8 years, 1906 to 1913	−15	−12	9	13	21	33	38	36	26	15	− 1	− 2	.....
For 1913	−10	3	10	17	21	39	42	42	27	21	15	13	.....
Mean:													
8 years, 1906 to 1913	31.5	36.8	43.1	50.9	56.1	64.9	73.3	71.2	61.1	50.1	40.4	31.7	.....
For 1913	28.4	32.6	40.7	49.2	58.5	63.4	70.0	71.85	64.5	50.4	42.1	30.35	.....

[1] The months of January, February, and March are averaged for five years and the remaining months for six years, ending 1913.

TABLE I.—*Summary of climatological observations at the Truckee-Carson Experiment Farm, 1906 to 1913, inclusive*—Continued.

KILLING FROSTS.

Year.	Last in spring.	First in fall.	Frost-free period.
			Days.
1906	May 31	Oct. 4	126
1907	May 14	Sept. 19	128
1908	May 30	Sept. 25	118
1909	May 24	Sept. 22	121
1910	May 16	Oct. 13	150
1911	May 27	Sept. 18	114
1912	May 22	Sept. 25	126
1913	May 13	Sept. 23	133
Average	May 22	Sept. 26	127

The principal unusual climatic features of the 1913 season were the early date of the last killing frost in the spring and the comparatively high rainfall, particularly during May, June, and July, when the rainfall is usually very low. The frost-free period began ten days earlier than the average date based on eight years' observations, and earlier than in any other year since observations were begun, in 1906. The rainfall, 8.09 inches, was practically double the 8-year average, and much of the precipitation came during the growing season, so that it greatly benefited the field crops.

AGRICULTURAL CONDITIONS.

During the season of 1913, crop conditions on the project were only fairly satisfactory. Beginning in the latter part of June there was a marked shortage of irrigation water and some of the field crops suffered, although the situation was somewhat relieved by heavy rains on the watershed late in July. The sugar-beet crop on some farms was badly damaged by cutworms in May. The average yields of alfalfa and wheat were higher than in 1912, but lower average yields were obtained from barley, oats, sugar beets, and potatoes.

The farm values of crop products, as estimated by the United States Reclamation Service, were somewhat lower for some crops and higher for others than in 1912. Better prices were secured for sugar beets and potatoes, but the prices offered for wheat, oats, and barley were rather lower than they were a year ago. The price of alfalfa hay averaged about $7 a ton, the same as in 1912. The average value per acre of all crops in 1913 was $12.92, which was 9 cents higher than in 1912.

The total irrigable area of the 494 farms on the project in 1913 was 56,955 acres, of which an area of 43,075 acres was actually irrigated. The acreage, yields, and farm values of the crops grown in 1913 are stated in Table II, the figures being obtained from the United States Reclamation Service.

TABLE II.—*Acreage, yields, and farm values of crops grown on the Truckee-Carson project in 1913.*

Crop.	Area.	Unit of yield.	Yield.			Farm value.			
			Total.	Per acre.		Per unit of yield.	Total.	Per acre.	
				Average.	Maximum.			Average.	Maximum.
	Acres.								
Alfalfa hay	13,960	Ton	45,132	3.23	7.00	$7.00	$315,924	$22.61	$49
Alfalfa, young	4,523	do					3,518	.78	
Other hay	3,467	do	4,001	1.15		7.00	28,007	8.05	
Wheat	1,590	Bushel	30,271	19.03	33.00	.85	25,730	16.17	28.05
Barley	1,880	do	43,238	23.00		.60	25,941	13.80	
Oats	283	do	10,274	36.30		.40	4,109	14.52	
Sugar beets	1,079	Ton	9,460	8.76	18.50	6.00	56,760	52.50	101.00
Potatoes	416	Bushel	29,789	71.60	700.00	.75	22,341	53.70	515.00
Native pasture	18,352						36,457	1.98	
Garden	180						19,779	109.80	
Onions	38	Bushel	10,915	287.23	875.00	.80	8,732	229.78	700.00
Miscellaneous	336						7,707	22.93	
Young orchards	132								
Less duplications	3,293								
Total	42,943						555,007		
Average value per acre								12.92	

The acreage of wheat, oats, and barley was smaller in 1913 than in 1912, but there was a decided increase in 1913 in the acreage of alfalfa, sugar beets, and native pasture. The total area from which crops were harvested increased from 36,620 acres in 1912 to 42,943 acres in 1913, a gain of 6,323 acres. Of this gain an area of 3,348 acres was included in native pasture.

One of the chief factors in the development of the project in 1913 was the rapid growth of the dairy industry. Many farmers have engaged in this enterprise, and the prospects for success are generally good. Large numbers of dairy stock were brought in from other districts during the year. Cow buying was financed chiefly by the local creamery company, which sold the dairy stock to farmers on favorable terms. The creamery company imported about 500 head of stock for distribution to farmers on the project. According to statistics secured by the United States Reclamation Service there were 1,728 dairy cows on the project at the end of the year. During the last three months of the year the local creamery purchased butter fat from about 800 cows and in return paid the farmers $16,800.

FIELD-CROP EXPERIMENTS.

On account of the great lack of uniformity in the soil of the experiment farm and the presence of harmful quantities of alkali salts, the field-crop experiments have not been extensive. Until the experiments which are being conducted with a view to removing the alkali salts from the soil are successfully applied to the entire farm, the crop

experiments will be limited in number and in land area used. A brief account of the more important field crop tests conducted in 1913 follows.

ALFALFA.

Approximately 13 acres of land on the experiment farm are planted to alfalfa for soil-improvement purposes and to produce forage for the work animals. The yields of the second and third crops in 1913 were reduced by the shortage of irrigation water after the month of June. The first crop yielded 1.83 tons per acre, the second crop 0.86 ton, and the third crop 0.44 ton, the total yield for the year being 3.14 tons per acre. This is slightly below the average yield for the entire Truckee-Carson project, as shown in Table II.

Varieties.—Seed of 12 varieties of alfalfa, furnished by the Office of Forage-Crop Investigations, was planted in the spring of 1911 in duplicate, in rows 30 inches apart, varying in length from 320 to 336 feet. In 1912 these varieties were cut three times and in 1913 twice. The yields for the two years are given in Table III. The seed of *Medicago ruthenica* did not germinate, and this variety is therefore not included in the table.

TABLE III.—*Yields of alfalfa varieties in row tests at the Truckee-Carson Experiment Farm in 1912 and 1913.*

Variety.	Yield per 100 feet of row (pounds).			Variety.	Yield per 100 feet of row (pounds).		
	1912	1913	Total for two years.		1912	1913	Total for two years.
Caucasus	126	99	225	Montana	113	109	222
Arabian	79	36	115	Canadian	117	98	215
Peruvian	114	113	227	Western Grown	117	109	226
Grimm	131	110	241	Provence	96	85	181
Sand lucern	84	100	184	Elche	79	80	169
Turkestan	108	101	209				

From the results obtained it would appear that the five best varieties are Grimm, Peruvian, Western Grown, Caucasus, and Montana. There was little difference in the yield of the last four varieties. The Elche is fine stemmed and lodges badly when planted in cultivated rows.

Time of cutting.—Experiments to determine the influence of time of cutting on the yield of alfalfa were conducted in 1913. Because of the irregularity of soil conditions at the experiment farm it was necessary to conduct the tests on a small scale. Fifteen galvanized-iron bands, 3 feet in diameter, were placed in a field of alfalfa where the growth appeared to be uniform. The experiments were conducted in triplicate. The freshly cut alfalfa was placed in light cloth sacks and weighed immediately. The sacks were then hung in the open air

until the alfalfa ceased to lose weight. The lowest weights were then recorded and the results calculated. The process of drying in this manner required from two to four weeks.

In the first crop, the first cutting was made on June 2, at the appearance of the first bloom, and the remaining cuttings approximately one, two, three, and four weeks thereafter. The first cutting of the second crop was made July 16, when the first blossoms appeared, and the remaining series approximately two, four, six, and eight weeks thereafter. Although these cuttings were two weeks apart, each succeeding cutting was only one week farther toward maturity than the preceding one, as they were cut at intervals of one week in the first crop. The length of the growing period allowed before cutting each crop and the yields obtained in 1913 are given in Table IV. It is assumed that growth began about April 1. The yields given are the total yields obtained from three areas in each case.

TABLE IV.—*Length of growing period and yields (dry weight) of alfalfa in the time-of-cutting experiments, Truckee-Carson Experiment Farm, 1913.*

Cutting.	First crop.		Second crop.		Third crop.		Total yield.
	Period of growth.	Yield.	Period of growth.	Yield.	Period of growth.	Yield.	
	Days.	*Grams.*	*Days.*	*Grams.*	*Days.*	*Grams.*	*Grams.*
First	63	1,157	44	885	83	560	2,602
Second	70	1,225	51	825	68	500	2,550
Third	79	1,535	56	810	54	330	2,675
Fourth	85	1,525	66	800	.....	.....	2,335
Fifth	96	1,775	68	645	.....	.....	2,420

The results of these experiments indicate that the increased yield obtained from making three cuttings a year instead of two is not sufficient to pay for the added expense of making the third cutting. The areas cut three times yielded on the average less than 10 per cent above the areas cut twice. However, it should be remembered that the above figures are based on the yields obtained in a single year and that seasonal differences might modify the results in other years.

It was found in the above experiments that the time of cutting had no important influence on the moisture content of the green alfalfa. The average moisture content of all the samples was 76.5 per cent of the green weight.

Frequency of irrigation.—Experiments in duplicate to determine the effect of varying frequency of irrigation on the yield of alfalfa were conducted in the following manner: Cylinders of galvanized iron, 30 inches long and 16 inches in diameter, were driven to a depth of 24 inches in the soil in a portion of a field of alfalfa where the stand was apparently uniform. Irrigation water was added to the

cylinders to a depth of 3 inches (19 pounds to a cylinder) at intervals of time shown in Table V. The figures given represent the average green weight, in grams, of the alfalfa in two cylinders in each case.

TABLE V.—*Yields of alfalfa irrigated with varying frequency at the Truckee-Carson Experiment Farm in 1913.*

Irrigation interval.	Yield of green weight (grams).			
	Cut July 11.	Cut Aug. 20.	Cut Oct. 6.	Total from three cuttings.
1 week	290	230	138	658
2 weeks	258	158	97	513
3 weeks	200	121	78	399
4 weeks	233	88	83	404
5 weeks	218	132	73	423
6 weeks	243	69	58	370

It will be noted that the more frequent irrigations generally resulted in increased yields, although the results were not consistent. The cylinders irrigated every week produced the greatest yields and those irrigated every six weeks gave the lowest yields, but the variations in yield between these two extremes were not regular. This discrepancy was apparently due in part to lack of uniformity in the soil. It was noticeable that one of the cylinders irrigated every three weeks always produced a very low yield of alfalfa. Although the results of these experiments indicate that frequent irrigation produces the greatest yield of alfalfa, it must not be assumed that this will be the case when tried on a field scale. Under field conditions frequent irrigation might result in a rise of the water table, with a consequent detrimental influence on the growth of the alfalfa. The experiment will be conducted again under varying conditions.

POTATO VARIETY TEST.

Twelve varieties and strains of potatoes were tested at the experiment farm in 1913. The varieties were planted in duplicate in rows 300 feet long, but after the potatoes were partially grown it was found that the soil was very spotted. At harvest time it was decided to take the yields from a comparatively small portion of the field, where the growth of potatoes was uniform and where the soil contained no "bad spots." The rows in the portion of the field from which comparative yields were obtained were 50 feet long. The yields are given in Table VI.

TABLE VI.—*Yields of 12 varieties of potatoes tested at the Truckee-Carson Experiment Farm in 1913.*

Variety.	Yield per 100-foot row (pounds).		
	Marketable.	Usable.	Total.
Burbank	29	36	65
Burbank Selected	40	24	64
White Beauty	36	25	61
Colorado Mammoth Pearl	45	32	77
Rural New Yorker	21	25	46
Red Ohio	23	20	43
Early Ohio	27	18	45
Extra Early Ohio	22	12	32
White Ohio	24	14	38
Early Triumph	34	25	59
Extra Early Triumph	26	36	62
Early Rose	52	32	84

From the results obtained it seems that Early Rose, Colorado Mammoth Pearl, and Burbank are the best yielding varieties. At harvest time it was found that the Burbank and White Beauty varieties were much more inclined to start new growth than any of the other varieties.

TOMATO VARIETY TEST.

Nine varieties of tomatoes were tested at the experiment farm in 1913. The seeds were planted in the greenhouse on March 10 and transplanted to the field on May 26. Fifty plants of each variety were set out, but a few failed to survive the transplanting, so that in most cases less than the full number came into bearing. The date of first ripening and the yields obtained are given in Table VII.

TABLE VII.—*Date of first ripening and yields of nine varieties of tomatoes tested at the Truckee-Carson Experiment Farm in 1913.*

Variety.	Number of plants.	First ripe.	Yield (pounds).	
			Total.	Per plant.
Stone	44	Aug. 14	391	8.9
Globe	39	Aug. 28	304	7.8
Select Stone	43	do	300	7.0
Early Wonder	38	Aug. 25	249	6.5
Trophy	49	Aug. 21	292	6.0
Coreless	45	Sept. 4	228	5.1
Royal Red	49	Aug. 26	244	5.0
Early Hustler	50	Aug. 24	241	4.8
Dwarf Champion	44	Aug. 15	204	4.6

The best yielding varieties were the Stone and the Globe, and they were also the most desirable as to shape and quality. The poorest yielding variety was the Dwarf Champion, which in previous years has been one of the best. Early Hustler is an early variety, but it is undesirable because the vines are weak and lie flat on the ground and because the plants are comparatively leafless and the fruits are thus exposed to the direct rays of the sun. Both of these causes

result in damaged fruit. The Trophy is an undesirable variety on account of the irregular shape of the fruit and the lack of uniformity in ripening. It was found that sometimes one side of a tomato of this variety would be green when the other side was well ripened.

ONION VARIETY TEST.

A test was made in 1913 with 13 varieties of onions. The soil was somewhat alkaline, and a very low yield was obtained, although the stand of all varieties was good. The yields, given in Table VIII, are from four rows of each variety, each row being 75 feet in length. The figures represent yields of marketable onions, the unmarketable onions not having been weighed.

TABLE VIII.— *Yields of 13 varieties of onions tested at the Truckee-Carson Experiment Farm in 1913.*

Variety.	Yield per plat.	Variety.	Yield per plat.
	Pounds.		*Pounds.*
Brown Australian	84	Yellow Flat Danvers	35
Prizetaker	75	Extra Early Red Flat	25
Yellow Danvers	58	Silver Skin	24
Mammoth Silver King	52	Southport White Globe	23
Southport Red Globe	39	Gigantic Gibraltar	12
Red Wethersfield	37	White Italian Tripoli	10
Oregon Yellow Danvers	37		

Of the above varieties, Brown Australian was the most uniform in shape, and it produced the smallest percentage of culls.

TREES AND SHRUBS.

One of the important lines of work at the experiment farm is the testing of trees and shrubs to determine which kinds are best suited to the conditions on the project. The lands of the project are naturally almost barren of vegetation, so that it is important that suitable plants for shade and ornamental purposes be found and that their growth be encouraged. Some of the trees and shrubs growing on the grounds at the experiment farm are shown in figure 1.

In the work carried on at the experiment farm the following trees and shrubs have been found to be well adapted to the project: Carolina poplar, Norway poplar, Chinese balsam poplar, black locust, Russian golden willow, Russian oleaster, American elm, Karagatch elm, and a tall-growing willow from China (S. P. I. No. 22450).

In order to encourage the growing of these varieties it has been the practice to distribute large numbers each spring to residents of the project. Cuttings of the poplars and willows and seeds of the Russian oleaster are planted in the nursery each year, to be grown for local distribution. In 1913 approximately 2,000 poplar trees and

cuttings, 1,500 Russian oleaster plants, 1,000 tamarisk cuttings, and 50 Karagatch elm trees were distributed.

Of each of five varieties of basket willow 500 cuttings were received from the Forest Service in the spring of 1913. Most of these cuttings were planted on the Indian School farm, 10 miles east of Fallon. This work is carried on in cooperation with the school. It is the intention of the superintendent of the school to establish a basket-making industry among the Indians if the growing of basket willows is found to be practicable. At least two years more will be required to test these varieties. The varieties planted were Americana, American Green, Purple, Purple Number Two, and Patent

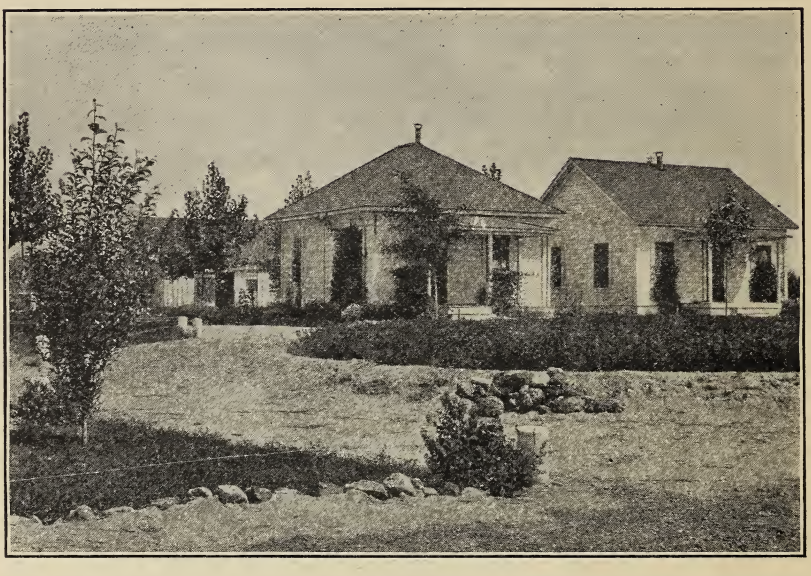

FIG. 1.—Part of the grounds of the Truckee-Carson Experiment Farm. A large number of trees and shrubs have been distributed among the farmers for use in beautifying home grounds.

Lemly. Because of rather poor care, these varieties made but little growth during the season. Most of the plants lived, however, and with proper care they will probably do well.

CAUSE OF THE SPOTTED CHARACTER AND GENERAL NONPRODUCTIVITY OF SOILS IN PORTIONS OF THE PROJECT.

A large part of the soil of the experiment farm is relatively nonproductive, and some of it is of such a nature that practically no crops have been produced, although it has been farmed for six years. Still other portions are as fertile as could be desired, and heavy yields of alfalfa and truck crops are obtained.

This spotted condition of the soil is not confined to the experiment farm, but is typical of small areas in every portion of the project. For

this reason the subject is of general interest, and much study has been given to find the cause. Examinations have been made of hundreds of samples of soil taken from every portion of the project. The results obtained quite definitely locate the cause of the low productivity of some of these soils to be the presence of an excessive amount of one or more of the alkali salts.

The alkali salts found are chiefly the carbonate, bicarbonate, sulphate, and chlorid of sodium, although potassium and magnesium bases are present to some extent. For these studies it has been found sufficiently accurate to calculate all the soluble salts as sodium salts. This greatly reduces the labor of making the analyses and the resulting errors are practically negligible. In this discussion, then, only sodium carbonate, sodium bicarbonate, sodium sulphate, and sodium chlorid will be considered.

Sodium carbonate.—The most harmful of these salts is sodium carbonate, or "black alkali," as it is commonly called. This salt is so toxic to plants that as small an amount as 0.05 per cent (less than 1 ounce in 100 pounds of soil) will seriously check the growth of alfalfa or other cultivated plants. When a crust of this salt is formed on the surface of the ground it is usually of a brown color, but is sometimes black or nearly so. It is not necessarily visible to the eye when present in sufficient quantity to injure plant growth.

One of the harmful features of this salt is that it has the property of rendering soils more or less impervious to water, so that it is not easy to leach out by heavy applications of water. Water seldom passes readily through black-alkali soils.

Sodium bicarbonate.—This salt has been found present to some extent in all samples analyzed. It is not so injurious to plants as sodium carbonate or sodium chlorid, but under certain conditions which may exist in the soil it is changed to sodium carbonate, so that it may be called a "potential black alkali" and is therefore a dangerous salt.

Sodium chlorid.—Sodium chlorid comes next to sodium carbonate as an injurious salt, but since it does not render the soil in the least impervious to water, its presence in the soil in harmful quantities is not to be so much dreaded by the farmer.

Sodium sulphate.—Sodium sulphate is the least harmful of the salts named. This salt, together with sodium chlorid, constitutes the greater part of the so-called "white alkali" found in the soils of the project.

RECLAMATION OF ALKALI LANDS.

Certain areas in every portion of the project may be found where the soil is covered with a crust or layer of alkali, and on some of these lands, where the alkali is not disturbed by irrigation, the deposits are annually getting thicker.

In these locations where there is poor drainage and a resulting high water table there is a constant upward movement of water, which brings with it salts in solution to be left at the surface of the ground upon the evaporation of the water. Seepage of water from a ditch, canal, or pond may have the same effect on adjacent lands as if a high water table were present, for the strata of soil may be such that the seepage water from the ditch or pond will move laterally and upward, carrying with it the salts dissolved in its passage through the soil.

Wherever there is an accumulation of salts resulting from lateral seepage or capillarity, it will be necessary to remove the cause before the alkali can be permanently removed. Even if the accumulation of salts from the surface of such lands were entirely removed by heavy flooding or by mechanical means, a new deposit would at once begin by the agency of the water brought from the reservoirs below.

To reclaim permanently lands of this character it will be necessary to cut off the seepage or lower the water table by means of drainage to such a depth that there is no further rise of water from beneath. When this is done, the salts, being once removed, will not again return to the upper soil, and the reclamation is permanent so long as the water table remains at a sufficient depth beneath the surface.

In some cases the soil containing an excess of alkali salts is impervious to water and the salts can not be leached out by applications of water to the surface, even though the water table is at such a depth that it does not interfere with the downward movement of the water. In many cases the soil is so absolutely impervious that the water remains on the surface until removed by evaporation.

When soil is of this nature it is obvious that the providing of good drainage will not of itself remedy the saline conditions. Methods must be used which will make the soil sufficiently porous to allow the downward movement of the water. It is probable that the plowing under of organic matter, such as a growing crop of sweet clover or an application of coarse manure, will help to some extent, but the tests so far made with this method at the experiment farm have brought negative results. Laboratory tests and greenhouse tests with large cylinders indicated that both gypsum and quicklime greatly increased the porosity of the soil.

The action of gypsum (calcium sulphate) is to change the sodium carbonate to sodium sulphate and calcium carbonate, both relatively harmless salts. The action of quicklime (CaO) is to unite with the sodium carbonate to form sodium hydrate and calcium carbonate. Sodium hydrate (commonly called lye) is toxic to plants. For this reason the use of lime in reclaiming black-alkali soils would not be so desirable as the use of gypsum.

INSTALLATION OF A DRAINAGE SYSTEM.

During the winter of 1912–13, a drainage system having a total length of approximately 2,620 feet was put in. The drain was constructed of redwood and was laid at an average depth of 4½ to 5 feet. The location of the tile is shown on the map, figure 2. The tile empties into a sump 12 feet square and 7 feet deep. The water from this sump is pumped into the surface drainage ditch built by the United States Reclamation Service along the east side of the experiment farm. The pump is a 3-inch centrifugal, operated by an

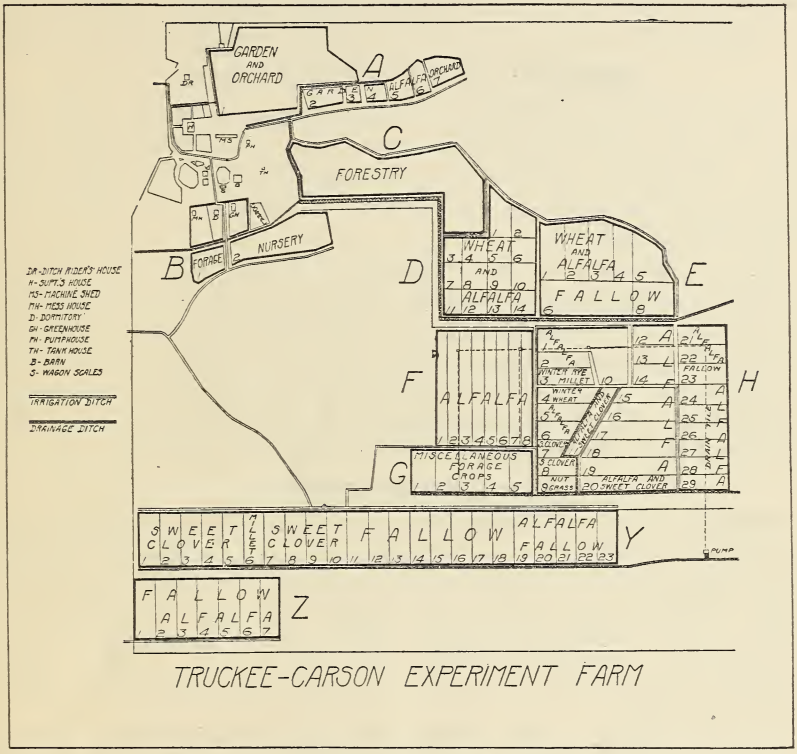

FIG. 2.—Diagram of the Truckee-Carson Experiment Farm, showing the arrangement of the fields used for the experiments which are being carried on.

electric motor. The discharge of the pump is slightly over one-half cubic foot of water per second. The motor operates automatically, starting when the sump is full and stopping when it is emptied.

It was determined by actual measurement of the water pumped from the sump that each watt of electricity used pumped 1.195 second-feet of water. Using this as a basis, the total amount of water pumped each month was calculated. Weekly analyses of water were made. The total alkali salts removed by the drainage system are shown in Table IX.

TABLE IX.—*Quantity of electricity used and the quantities of water and of total salts pumped by the drainage system at the Truckee-Carson Experiment Farm in 1913.*

Month.	Electricity.	Water pumped.		Average salts.	Salts pumped.
	Kilowatts.	*Cubic feet.*	*Pounds.*	*Per cent.*	*Pounds.*
January	18	21,510	1,344,375	0.250	3,361
February	26	31,070	1,941,875	.239	4,641
March	60	71,700	4,481,250	.232	10,397
April	100	119,500	7,468,750	.285	21,286
May	125	149,375	9,335,937	.323	30,155
June	66	78,870	4,929,375	.296	14,591
July	38	45,410	2,838,125	.247	7,010
August	28	33,460	2,091,250	.196	4,099
September	34	40,630	2,539,375	.184	4,672
October	30	35,850	2,240,625	.179	4,011
November	24	28,680	1,792,500	.187	3,352
December	29	34,655	2,165,937	.183	3,963
Total	.....	690,710	43,169,374	.....	111,538

EXTENSION OF THE DRAINAGE SYSTEM.

Ever since the establishment of the experiment farm in 1906, the field known as "Y" has failed to produce a successful crop of any kind. Chemical examination of the soil indicated that the trouble is caused by the presence of an excess of alkali salts, the chief cause being black alkali.

As a preliminary to the reclamation of this land, the work of running a 10-inch line of draintile along the south side of this field was begun in November, 1913. It is intended that the 10-inch tile shall extend the entire length of the series at a depth of 4½ to 5 feet and that 4-inch laterals shall branch from the main drain into certain of the plats. The main drain empties into the sump, together with the water from the drainage system installed the previous year.

CIRCULARS DISTRIBUTED.

During the year 1913, circular letters, treating of subjects of more or less local interest but not of sufficient general interest to justify their being issued in printed form, were sent to all the local water users. The circulars issued were entitled "General Observations on Alkali Soils," "Blight of Apples and Pears," and "Outline of an Experiment to Reclaim Ten Acres of Land Containing Black Alkali and Other Salts."

Probably most of the farmers on the Truckee-Carson project possess some land which is not productive because of the presence of alkali salts, and the alkali problems discussed in two of these circular letters are therefore of considerable local interest. The circular letter on "Blight of Apples and Pears" was issued because the presence of blight in several of the older orchards of the project made it advisable to send out a warning which might help in checking the spread of this disease.

Approved:

WM. A. TAYLOR,
Chief of Bureau.

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